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Atmospheric Chemistry and Physics Discussions

Interactive comment on "First comprehensive modelling study on observed new particle formation at the SORPES station in Nanjing, China" *by* X. Huang et al.

Anonymous Referee #1

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This manuscript "First comprehensive modelling study on observed new particle formation at the SORPES station in Nanjing, China" presents measurements and modeling of new particle formation (NPF) events with the intention to investigate the contribution of different chemical compounds and aerosol properties on the formation and growth to 6 nm aerosol particles. It is fairly well written and the modeling tools used in the study are of good quality. However, some of the details of the methods are missing. It is also unclear, what is the main outcome of this study and how the scientific community would benefit from it. This should be clarified by the authors. In addition, Abstract and Conclusions do not include any quantification of the results. For example, it is said that "simulated NPF events were generally in good agreement with the corresponding

measurements" but it is not explained which parameters are in good agreement and what qualifies as "good agreement".

Major comments:

- It is unclear how the nucleation coefficient k_1 is determined for Equation (1). On Page 27506 it is said they were chosen "after comparing the simulations and DMPS measurements". This should be explained better. If the nucleation coefficient is tuned to match the model to measurements, wouldn't it be obvious that the model is in good agreement with the measurements?
- In addition to my previous point, the values of k_1 are extremely low. For example, Pietikäinen et al. 2014, use $k_1 = 1.4 \times 10^{15}$ and that is for the formation rate of 3 nm particles. For 1.5 nm particles it would be even higher. Could these extremely low values of k_1 explain why the nucleation events start too late in the model?
- Since only three NPF events are investigated, it is unclear how well the model configuration reproduces observed NPF events in general. For example, has it been tested if the modeled frequency of NPF events is similar to observations?
- One of the main results of the study is that biogenic organic compounds play an essential role in condensational growth of newly formed clusters. Model results supporting this finding are missing. Have you, for example, investigated the modeled fraction of these biogenic organics in 6 nm particles? If the fraction is significantly high in these particles, it would strenghten your case.
- Page 27516: It is said that the better correlation of using organic nucleation scheme is evindence for the involvement of ELVOC in NPF. Visual inspection

of this data suggest that this increase in the correlation comes only from the fact that $[H_2SO_4]^2$ has smaller variability than $[H_2SO_4]^{1.0}[ELVOC]^{0.8}$. Based on this approach activation type nucleation mechanism might have even higher correlation coefficient. In addition, the correlation coefficient seems to be calculated from the actual values while the x-data varies over 8 orders of magnitude, so it would have been more appropriate to calculate the correlation coefficients for the logarithm of the values. Please see the Referee #2 comments to improve this analysis.

Minor comments:

- Please check the grammar.
- How do you determine the OH radical concentration?
- Photochemistry can also play a significant role in NPF and the model's cloud cover can affect that signficantly. How well does WRF-Chem reproduce the cloud cover during these event days?
- The formation rate of 6 nm particles is not nucleation rate. A preferred term would be "new particle formation rate". Please correct this on Page 27515, Line 24, 25, and in the caption for Fig 7.
- Page 27506, Line 10: What do you mean by "good"?
- Page 27508, Line 20: Have you checked if this distribution is equal also in observations?
- Page 27513, Line 18: This wording "succeeds, on average, to generally reproduce" is very ambiguous. Please rephrase this.

- Page 27507, Line 25: What does "for further analysis and box modeling" mean in this context?
- Page 27510, Line 18: 500 000 $\#cm^{-3}$ can not be the correct value as it is extremely high.
- Page 27512, Lines 17-18: It is said that "On one hand, humid air mass transported from the ocean might have favored the particle growth". Please explain the reasoning behind this sentence.
- Page 27514, Line 17: The word "concentration" is missing?
- Figure 5: Having different y-scales in the right column plots make the comparison of the events difficult.

Pietikäinen, J.-P., Mikkonen, S., Hamed, A., Hienola, A. I., Birmili, W., Kulmala, M., and Laaksonen, A.: Analysis of nucleation events in the European boundary layer using the regional aerosol–climate model REMO-HAM with a solar radiation-driven OH-proxy, Atmos. Chem. Phys., 14, 11711-11729, doi:10.5194/acp-14-11711-2014, 2014.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 27501, 2015.